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ABSTRACT

Data from the Computers in Education project (Comped) are used to study the state of the art with respect to gender and computer use in a number of countries. The Comped project of the International Association for the Evaluation of Educational Achievement (IEA), which was conducted in about 20 countries in 1989, involved over 70,000 students in 10 countries in 1992. A Functional Information Technology Test was given to students in the Comped study. Results indicate that the gender equity concerns of many educators, who fear computer use causes or preserves differences between male and female students, are well founded. Females know less about information technology, enjoy using computers less, and perceive more software problems than males. Sex of students is a factor with substantial influence on student achievement internationally. Possible causes for the differences and what might be done about them are outlined. One table and five figures illustrate the analyses. (Contains 10 references.) (SLD)

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GENDER AND COMPUTER USE:

ANOTHER AREA OF INEQUITY?

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GENDER AND COMPUTER USE: ANOTHER AREA OF INEQUITY?

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Objectives

Using the principal data source of the Computers in Education project (Comped), carried out under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), the purpose of this paper is to study the state of the art with respect to gender and computer use in education in a number of countries (among them the USA, Japan, the Netherlands, Germany and Austria). Is this innovation in education widening the gap between female and male students in the sense of possibilities to work with this new technology, the knowledge about computers and the skills to work with them, or does the computer provide a means to close this gap? And in case inequity in the area of educational computer use is a fact, what are the possible causes of this inequity and what might be done in the near future to improve the situation?

Perspectives/theoretical framework

Much research has been done on the effects of computer use on female as well as male students and it is found in a number of research projects that the daily practice concerning the use of computers in education by female and male students does not reflect the principle of equality (Voogt, 1987; Durndell, Macleod & Siann, 1987; Damarin, s

1989). Janssen Reinen and Plomp (1994) give a summary of the factors found in research on equity and computers. Using Sutton's (1991) framework, the following categories of factors have been found to reflect the difference between female and male students:

Input: access and socialization

Differences in access to computers (at school as well as at home) and different socialization experiences are important contributors to gender differences in computer use.

Process: equity issues in school

Factors found to influence gender inequality are:

- female role models in the class (or the number of female teachers working with the computer in the school and the type of role model they furnish);
- organizational issues (like schools being co-educational or not, or timetabling of school subjects);
- type of computer use in school (with gender differences mainly appearing in programming courses and voluntary activities).

Output: student attitudes and ability

As a result of the home and school situation with regard to computers, research claims that

gender differences appear in attitudes towards computers, knowledge about computers and skills to work with computers (Durndell et al., 1987; Martin, 1991; Siann et al., 1990).

The above framework to map out gender differences is used to analyse the Comped data. First of all a look at the output variable shows whether differences are found in the Comped study with regard to knowledge about computers and attitudes towards computers. Factors mentioned in the framework as input or process variables are studied here as possible sources of gender differences in knowledge and attitudes.

Data source

The data used for this paper are collected in IEA's international survey called Comped (Computers in Education). In about 20 different countries in 1989 and in 10 countries in 1992, data were collected on the use of computers in elementary, lower and upper secondary education. In each country, a national representative sample was drawn from computer using and non using schools. Questionnaires were given to principals of schools, computer coordinators and teachers (both computer using teachers as well as teachers who do not work with it). In 1992 data were also collected from students, via a functional information technology test (FITT), an attitude questionnaire and a background questionnaire.

Data from this project allow us to study the gender perspective from different angles: the degree of computer use in the schools, the problems experienced, the attitudes towards computers and the way students look at this new technology. Many influencing factors as found in earlier research and theory to be of relevance for the gender debate were taken into account when studying the Comped data.

Table 1 shows the distribution of females and males in the samples of students in the target grades of the study. Only in India in upper secondary education, the percentage of female students is considerably lower than the percentage of male students, while the situation is reverse in Bulgaria in upper secondary education. Furthermore, the distribution is rather equal.

Table 1. Total number of tested students (#) in the sample of the target grade* and percentage girls (%g)

	Elementary Schools		Lower Secondary Schools		Upper Secondary Schools	
	#	%g	#	%g	#	%g
AUT	-	-	5,397	49	2,797	48
BUL	-	-	2,086	55	2,067	65
GER	-	-	1,463	49	-	-
GRE	-	-	3,635	52	-	-
IND	-	-	-	-	12,945	32
JPN	4,939	48	5,481	48	4,572	43
LAT	-	-	-	-	2,228	54
NET	3,615	52	4,905	50	-	-
SLO	-	-	-	-	3,431	58
USA	4,316	51	2,746	51	2,999	53

Notes: - = data not collected, * = for elementary and lower secondary schools one target grade was defined and only students from this grade are included in this chapter. For upper secondary education, the target grades differ among and within countries.

Abbreviations used: AUT=Austria, BUL=Bulgaria, GER=Germany, GRE=Greece, IND=India, JPN=Japan, LAT=Latvia, NET=Netherlands, SLO=Slovenia, USA=United States of America

Output: differences in knowledge, attitudes and problems experienced

A so-called Functional Information Technology-Test was given to the students in the Comped study. This is a test meant to measure the knowledge students have concerning general information handling and simple computer skills. We see the results on the FITT as an indication for student achievement in the field of computer use. For details with respect this test (content, reliability and validity) we refer to Pelgrum, Janssen Reinen and Plomp (1993). Figure 1 gives the score on the test (for secondary education a 27 item test, for elementary education a subset of this test consisting of 17 items), broken down by gender.

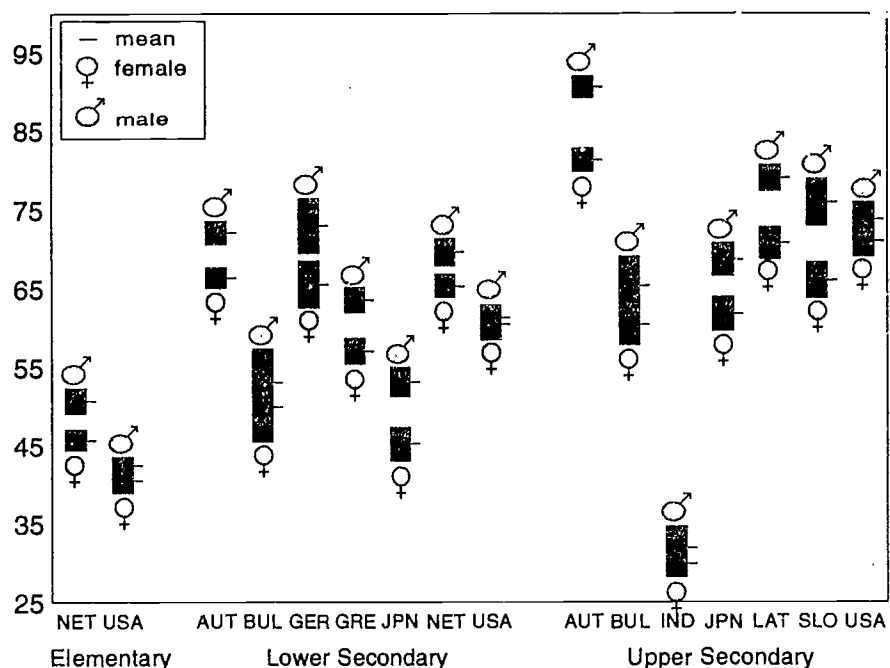


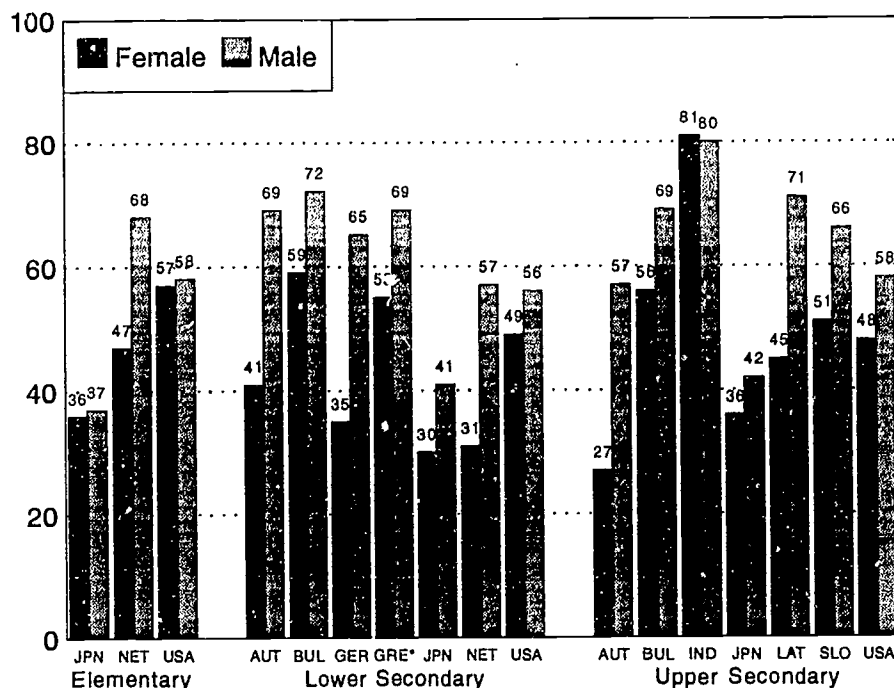
Figure 1. Mean FITT-score and 95% confidence interval for female and male students

Figure 1 shows that male students significantly score higher than females in most countries under study. Bulgaria, India and the USA are the countries in which no significant difference is found. Although the trend of the gender difference in FITT-score in all countries is clear, the picture shown in Figure 1 might be somewhat overstating the difference. When bringing back the difference in score between males and females to a difference in number of correct answered items on the test, in elementary school and some countries in lower and upper secondary school a difference of not more than one correct answered item is found. The difference in average number of correct items is never larger than 3 items in a test of 27 items. The largest difference is found in upper secondary education.

Next to the FITT, a background questionnaire was given to the students containing, amongst others, an attitude questionnaire consisting of the three scales 'relevance', 'enjoyment' and 'parental support'. Again, we refer to Pelgrum et al. (1993) for details about the content and reliability of the attitude scales.

With respect to the relevance scale, no significant differences are found between male and female students in most countries under study. Only in Austria, the Netherlands and Latvia male students are more convinced of the relevance of learning to work with computers.

When looking at the 'enjoyment' scale from a gender perspective, a different picture appears (Figure 2).



Notes: * =only students in computer using schools

Figure 2. Percentage (strongly) agree on attitude scale 'enjoyment' for both female and male students

In all countries (except Japan and the USA in elementary education and India in upper secondary education), female students tend to enjoy using the computer significantly much less than males do.

With respect to the problems students experience when working with computers, no clear and overall picture for all countries can be given. The only thing that is clear is that consistently over almost all countries in lower and upper secondary education females students report having more difficulty in understanding or using programs.

Overall, when looking at the current situation in educational computer use from the perspective of gender differences, the trends seem to point in the direction of a less positive situation for female students. They score lower on the FIT-test and their attitudes are less favorable than those of the male students, especially when looking at 'enjoyment to work with computers'. The most 'gender equal' picture on computer use by students is found in Bulgaria and the USA, while Austria, Germany and Latvia seem to be the countries with the largest gender differences in knowledge about, attitudes towards and problems with computers.

Input: socialization and access as possible causes of gender differences

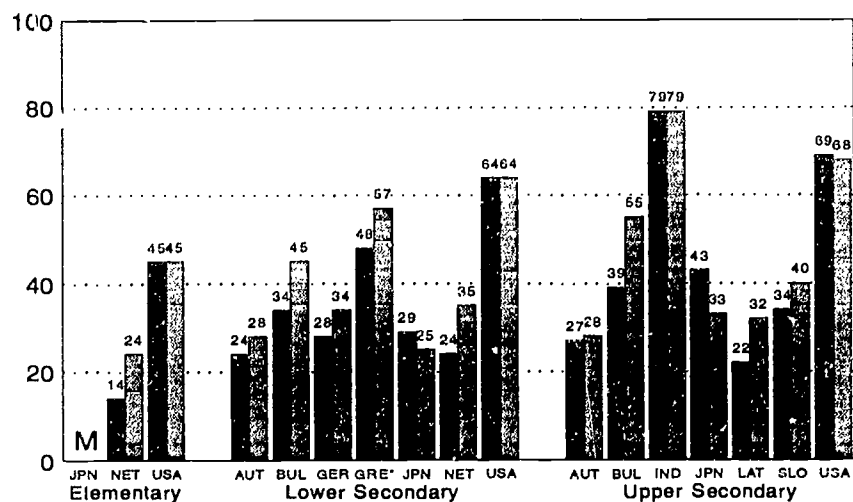
As indicated when describing the framework for gender differences, the factors that might

influence the difference between female and male students in their knowledge about and attitudes towards computers can be grouped as 'input variables' and 'process variables'. The first category deals with factors 'outside' the school environment while process variables deal with issues in the daily educational practice.

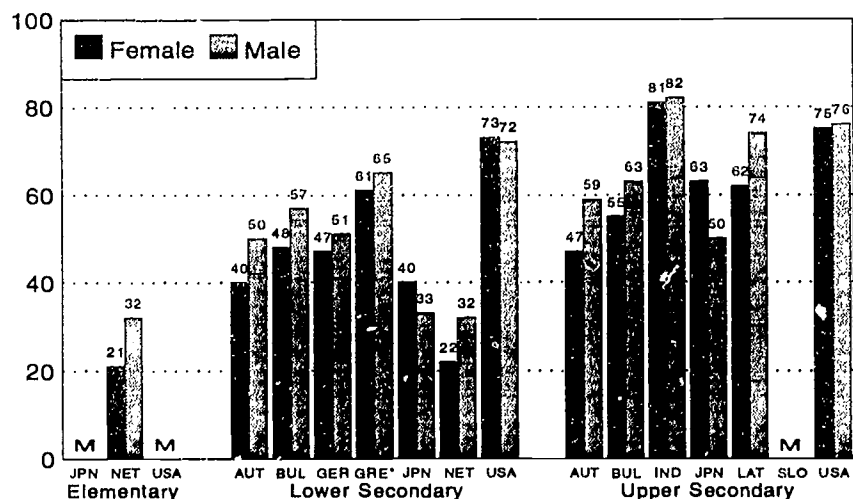
Socialization experience as one possible factor of influence on student outcomes in the field of computer use refers to the influence of differential socialization of males and females, often resulting in stereotypical sex-specific roles. These socialization differences can be influenced by the stimulation of parents or through imitation of 'significant others'. As Yeloushan (1989) states, a major social barrier for females is the attitudes of parents and teachers who believe that computers are learning tools predominantly for males.

When looking at the stimulation of parents in the field of computer use, Figure 3 shows what students think about their parental support.

Parents Encourage Me



Parents Want Me to be Good



Notes: M = information not available or too many missing cases (>20%), * = only students in computer using schools.

Figure 3. Percentage (strongly) agree on the parental support attitude items for both female and male students.

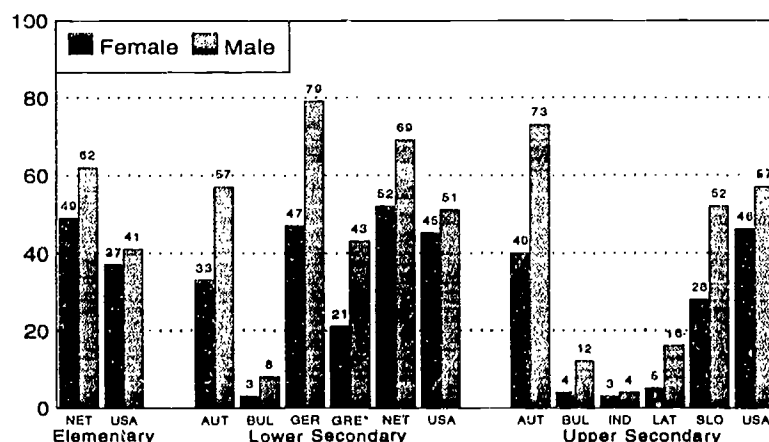
In some countries, the differences between female and male students on their agreement with both parental support items is noteworthy (like the Netherlands, Greece, Latvia and upper secondary schools in Bulgaria), indicating that males get more support from their parents. Only in Japan, girls agree more with the parental support items.

This result in attitudes might be an indication of the difference in socialization between girls and boys. However, some caution is necessary in interpreting the data because the way

students answered the opinion items might be influenced by socially desirability and, as such, the results might reflect the socialization role that is expected from students and not so much the objective amount of (or lack of) parental support.

Access to computers at home is another 'input indicator' for gender differences. In terms of the availability of computers at home (Figure 4), it is clear that male students have more possibilities to work with computers than females do. This difference is significant for all countries but the USA in elementary and lower secondary education and India in upper secondary education. Japan is not included in the Figure because this question was not asked.

Availability of Computer at Home



Notes: * = only students in computer using schools.

Figure 4. Percent female and male students indicating having a computer available at home.

Whereas Figure 4 only indicates the *availability* of computers at home, a look at the *use* of computers outside school (at home or at a friends' place) shows that especially in Bulgaria, Japan and Slovenia male students do work with the computer outside school more often than females.

Process variables: the role of the school with respect to gender differences

The use of the computer at school is an important process indicator that might explain gender differences. When comparing the use of the computer only at school or at school as well as outside school, it is found that in secondary education, females more often belong to the group that uses the computer only at school, while males more often appear in the group that uses the computer both at school and outside school. Thus, the school seems to be an important environment for female students to work with computers in the sense that it could

compensate for the lack of opportunity to work with computers outside school.

When looking at the type of activities students do at schools, it is found (Figure 5) that males are often engaged in a greater number of activities than females (regardless of the intensity of doing these activities).

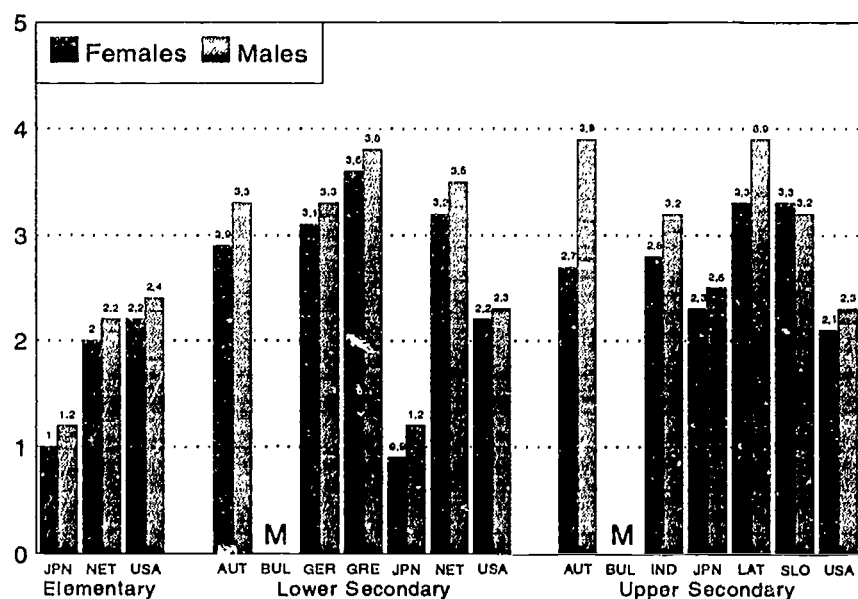


Figure 5. Mean number of activities carried out with the computer for female and male students who work with the computer at school or both at school and outside school.

One of the 'significant others' that might provide female students with a role model of how to use computers, is the computer coordinator or the teacher who uses the computer. If these persons are female, girls can get an example of women working with the computer. However, the data show that in most countries (except Bulgaria, Latvia and the USA), a majority of the staff positions is occupied by males. This situation is not much different from the situation in 1989, when the first COMPED data collection took place.

Within the schools, only a small minority of schools define a special policy in order to promote gender equity in the area of computer use. The impression is that the gender issue in the field of computer use is not considered to be of any importance in most schools. In case schools do have a special gender policy, it is directed towards training female teachers in computer education, giving teachers suggestions on how to promote equity or in-service sessions for teachers about equity.

Conclusion

This paper contains the first scientific international comparative results on student level in the field of computers in education and can as such provide policy makers and educational practitioners with important information on the gender differences in this area of education. The findings of the Comped data seem to indicate that the concern of many educational practitioners about gender equity that computer use causes or preserves differences between female and male students is well founded. At the output level, results indicate that females know less about information technology, enjoy using the computer less than male students, and perceive more software problems. A Multi-level analyses on the Comped data done by Ten Brummelhuis (1994) shows that the sex of students is a factor with a substantial influence on student achievement in the countries.

Possible causes of these differences as identified in this paper deal with differences in parental support, access to computers (in terms of availability and use), amount of female role models and activities carried out with the computer at school. Attitudes towards IT and home background are also found in the ML analyses to be meaningful factors in understanding differences in student achievement.

But do the Comped data also provide some clues for possible ways to improve this situation? The first step might be to recognize that gender differences are found both outside and inside school. This means that both parents and teachers have to be made aware of this situation as the basis for action in reducing the difference. As indicated in the section above, a school's policy concerning the gender issue is rare, and when a school has such a policy, it is not directed towards the parents. Concerning the teachers, the perspective chosen by a majority of schools seems to be the stimulation of female role models, but making both female and male teachers aware of the gender difference between male and female students is done as well.

The analyses on the Comped data seem to indicate that differences in FITT scores between female and male students are found for all countries included in the study except the USA and Bulgaria, all indicating that females score lower on the test. Factors that might contribute to this 'gender equal' situation might be the availability of female staff positions at school (especially in Bulgaria where the use of the computer outside school is very limited) and in the USA the equality of the home situation (parents stimulation and availability/use of computers outside school). In the more 'gender unequal' countries like Austria, Germany, Japan, Latvia and Slovenia the situation of working with computers outside school is at least less favorable for females. However, it is too early to state that these differences are fixed. As found in the Comped study, computer use in the schools is in many countries still quite limited and

developments are expected in the coming years. In that respect it is important for all people involved in this process of implementing the computer, to constantly keep in mind that this new technology should not broaden the gap between possibilities for female and male students.

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